Appl. No.: 10/563,233

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AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in this application.

1. (Currently Amended) A system for mixing a process gas flow that is flowing through a housing (92) of a kiln system (20), said system comprising:

at least one injector (84,86) provided to said housing (92);

a gas supply system (102) connected to said at least one injector (84,86) for supplying injection gas to said injector (84,86) at a predetermined pressure; and

wherein said injector (84,86) and said predetermined pressure are arranged and selected to inject said injection gas into the housing (92) at sufficiently high momentum to produce a jet having appropriate turbulent flow characteristics such that the process gas flow is entrained by said injected gas; and

wherein said injector (84,86) is provided with swirling means for providing axial swirl to said injected gas as it enters the housing of the kiln system (20).

2. (Previously Presented) A system according to claim 1, wherein the injector is arranged so that the gas flow is flowing through a housing (92) along an axis of said housing (92).

3. (Previously Presented) A system according to claim 1, wherein said swirling means comprises swirl vanes (100).

4. (Previously Presented) A system according to claim 3, wherein said swirl vanes (100) have an angle of approximately 10 to 35 degrees.

5. (Previously Presented) A system according to claim 1, wherein said injector (84,86) is provided with flare diffusers to enhance said entrainment.

6. (Previously Presented) A system according to claim 1, wherein said injector is provided with a bluff body to enhance said entrainment.

7. (Previously Presented) A system according to claim 1, wherein said injector is provided with a bluff body and flare diffusers to enhance said entrainment.

8. (Previously Presented) A system according to claim 5, wherein said flare diffusers are at approximately 5 to 20 degree half angles.

9. (Previously Presented) A system according to claim 1, wherein said process gas flow is substantially entrained before the injected gas flow is converted to plug flow along with the process gas flow or before the injected gas flow impinges upon an interior of the housing (92).

10. (Previously Presented) A system according to claim 1, said system comprising:

a plurality of injectors (84,86) provided to said housing (92) and arranged at predetermined intervals around a cross section of said process gas flow and in communication with an interior of said housing (92); and

a gas supply system (102) for supplying injection gas to said injectors at a predetermined pressure,

wherein said injectors (84,86) are directed to inject said injection gas to impinge tangentially on a circle (98) centered on an axis of said process gas flow and covering at least approximately 5 to 15 percent of a cross sectional area of said process gas flow.

11. (Previously Presented) A system according to claim 10, wherein said plurality of injectors (84,86) and said predetermined pressure are arranged and selected to inject said injection gas into the housing (92) at sufficiently high momentum to produce a jet having appropriate turbulent flow characteristics such that the process gas flow is entrained by the injected gas.

12. (Previously Presented) A system according to claim 11, wherein said process gas flow is substantially entrained before the injected gas flow is converted to plug flow along with the process gas flow or before the injected gas flow impinges upon an interior of the housing (92).

13. (Previously Presented) A system according claim 10, wherein said circle (98) covers at least approximately 5 percent of the cross sectional area of said housing (92).

14. (Previously Presented) A system according to claim 10, wherein said circle (98) covers approximately 10 percent of the cross sectional area of said housing (92).

15. (Previously Presented) A system according to claim 10, wherein said swirling means comprises swirl vanes (100).

16. (Previously Presented) A system according to claim 15, wherein said swirl vanes (100) have an angle of approximately 10 to 35 degrees.

17. (Previously Presented) A system according to claim 10, wherein said injectors (84,86) are provided with flare diffusers.

18. (Previously Presented) A system according to claim 10, wherein said injectors (84,86) are provided with bluff bodies.

19. (Previously Presented) A system according to claim 10, wherein said injectors (84,86) are provided with bluff bodies and flare diffusers.

20. (Previously Presented) A system according to claim 17, wherein said flare diffusers are at approximately 5 to 20 degree half angles.

21. (Previously Presented) A system according to claim 10, wherein said plurality of injectors (86) are directed at an angle of approximately 0 to 60 degrees in the direction of process gas flow.

22. (Previously Presented) A system according to claim 21, wherein said plurality of injectors (86) are directed at an angle of approximately 25 to 40 degrees in the direction of process gas flow.

23. (Currently Amended) ~~A system according to claim 10, wherein~~ A system for mixing a process gas flow that is flowing through a housing (92) of a kiln system (20), said system for mixing comprising:

at least one injector (84,86) provided to said housing (92);

a gas supply system (102) connected to said at least one injector (84,86) for supplying injection gas to said injector (84,86) at a predetermined pressure;

wherein said injector (84,86) and said predetermined pressure are arranged and selected to inject said injection gas into the housing (92) at sufficiently high momentum to produce a jet having appropriate turbulent flow characteristics such that the process gas flow is entrained by said injected gas; and

said injector (84,86) is provided with swirling means for providing axial swirl to said injected gas;

said system for mixing further comprising a plurality of injectors (84,86) provided to said housing (92) and arranged at predetermined intervals around a cross section of said process gas flow and in communication with an interior of said housing (92); and

a gas supply system (102) for supplying injection gas to said injectors at a predetermined pressure,

wherein said injectors (84,86) are directed to inject said injection gas to impinge tangentially on a circle (98) centered on an axis of said process gas flow and covering at least approximately 5 to 15 percent of a cross sectional area of said process gas flow,

said plurality of injectors (86) comprise a first set of injectors (86) and said system for mixing further comprises a second set of injectors (103) comprising:

at least one injector (103) provided to said housing, arranged at a second cross section of said housing (92) and in communication with an interior of said housing (92), and

a second gas supply system for supplying injection gas to said at least one injector (103) at a predetermined pressure, and

wherein said at least one injector (103) is directed to inject gas to impinge tangentially on a second circle (104) centered on an axis of said housing (92) that has a different diameter than the circle (98) of said first set (86) of injectors.

24. (Previously Presented) A system according to claim 23, wherein said second circle (104) has a larger diameter than said circle (98).

25. (Previously Presented) A system according to claim 23, wherein said second cross section of said housing (92) is spaced apart from said cross section of said first set of injectors (86) in the direction of process gas flow.

26. (Previously Presented) A system according to claim 23, wherein said gas supply system (102) for said first set of injectors further comprises said second gas supply system.

27. (Previously Presented) A system according to claim 1, wherein said injected gas is air or oxygenated air.

28. (Previously Presented) A system according to claim 1, wherein said injected gas is preheated.

29. (Previously Presented) A system according to claim 1, wherein said kiln system (20) is for preparing cement clinker and said system is in a region of said kiln system (20) where gas temperature is between approximately 850 to 1400 degrees Celsius.

30. (Previously Presented) A system according to claim 29, wherein said gas temperature is between approximately 1000 to 1250 degrees Celsius.

31. (Previously Presented) A system according to claim 1, wherein said housing (92) is a housing of a rotary kiln (42).

32. (Previously Presented) A system according to claim 1, wherein said housing (92) is a housing of an exhaust gas by-pass system.

33. (Previously Presented) A system according to claim 1, wherein said housing (92) is a housing of a precalciner.

34. (Previously Presented) A system according to claim 1, wherein said housing (92) is a housing of a gas riser duct (34).

35. (Previously Presented) A system according to claim 1, wherein said housing (92) is a housing of a precalciner in a region near a gas exit where gas temperature is between approximately 900 to 1250 degrees Celsius.

36. (Previously Presented) A system according to claim 1, wherein said housing (92) is a housing of said kiln system (20) in a region in which said system will enhance efficiency and completion of reactions with ammonia where gas temperature is between approximately 850 to 1050 degrees Celsius.

37. (Previously Presented) A method of mixing a process gas flow of a kiln system comprising:

providing a source of injection gas at high pressure; and

injecting said injection gas into said process gas flow via at least one injector at sufficiently high momentum to produce a jet having appropriate turbulent flow characteristics such that the process gas flow is entrained by the injected gas;

further comprising imparting swirl to said injected gas as it enters a housing of the kiln system (20).

38. (Previously Presented) A method of mixing a process gas flow according to claim 37, wherein said swirl is imparted by swirl vanes provided to said at least one injector.

39. (Previously Presented) A method of mixing a process gas flow according to claim 37, wherein said entrainment is further enhanced by a bluff body provided to said at least one injector.

40. (Previously Presented) A method of mixing a process gas flow according to claim 37, wherein said entrainment is further enhanced by a flare diffuser provided to said at least one injector.

41. (Previously Presented) A system according to claim 37, wherein said entrainment is further enhanced by a bluff body and a flare diffuser provided to said at least one injector.

42. (Previously Presented) A method of mixing a process gas flow according to claim 37, wherein a total momentum of said injected gas during injection is approximately 50 to 150% of a momentum of said process gas flow.

43. (Previously Presented) A method of mixing a process gas flow according to claim 37, wherein said injected gas is injected at or above approximately 150 meters/second.

44. (Previously Presented) A method of mixing a process gas flow in a housing of a kiln system comprising:

providing a source of injection gas at high pressure;

injecting said injection gas into said housing via at least one injector such that said injection gas impinges tangentially on a circle centered on an axis of said process gas flow and covering at least approximately 5 to 15 percent of a cross sectional area of said process gas flow; and

imparting swirl to said injection gas as it enters the housing.

45. (Previously Presented) A method of mixing a process gas flow according to claim 44, wherein said injecting of said injection gas into said process gas flow is at sufficiently high momentum to produce a jet having appropriate turbulent flow characteristics such that the process gas flow is entrained by the injected gas.

46. (Cancelled).

47. (Previously Presented) A method of mixing a process gas flow according to claim 45, wherein said swirl is imparted by swirl vanes provided to said at least one injector.

48. (Previously Presented) A method of mixing a process gas flow according to claim 45, wherein said entrainment is further enhanced by a bluff body provided to said at least one injector.

49. (Previously Presented) A method of mixing a process gas flow according to claim 45, wherein said entrainment is further enhanced by a flare diffuser provided to said at least one injector.

50. (Previously Presented) A method of mixing a process gas flow according to claim 45, wherein said entrainment is further enhanced by a bluff body and a flare diffuser provided to said at least one injector.

51. (Previously Presented) A method of mixing a process gas flow according to claim 45, wherein a total momentum of said injection gas during injection is approximately 50 to 150% of a momentum of said process gas flow.

52. (Previously Presented) A method of mixing a process gas flow according to claim 44, wherein said injection gas is injected at or above approximately 150 meters/second.

53. (Previously Presented) A method of mixing a process gas flow of a kiln system according to claim 44, wherein the Reynolds Number due to said mixing is approximately 2.5 times above that encountered in a typical process gas flow without said mixing.

54. (Previously Presented) A method of mixing a process gas flow of a kiln system according to claim 44, wherein the turbulent frequency due to said mixing is approximately 100 times above that encountered in a typical process gas flow without mixing.

55. (Previously Presented) A method of mixing a process gas flow of a kiln system according to claim 44, wherein a total momentum, turbulence and swirl of said injected gas are selected based on aerodynamic calculation such that said injected gas will substantially entrain the whole of said process gas flow before the injected gas flow is converted to plug flow along with the process gas flow or before the injected gas flow impinges upon an interior of the housing.

56. (Previously Presented) A method of mixing a process gas flow of a kiln system according to claim 44, wherein a total momentum, turbulence and swirl of said injected gas, are selected based on mathematical modelling such that said injected gas will substantially entrain the whole of said process gas flow before the injected gas flow is converted to plug flow along with the process gas flow or before the injected gas flow impinges upon an interior of the housing.

57. (Previously Presented) A rotary kiln of a kiln system provided with a system for mixing a process gas flow according to claim 1.

58. (Previously Presented) A precalciner of a kiln system provided with a system for mixing a process gas flow according to claim 1.

59. (Previously Presented) An exhaust gas by-pass system of a kiln system provided with a system for mixing a process gas flow according to claim 1.

60. (Previously Presented) A preheater section of a kiln system provided with a system for mixing a process gas flow according to claim 1.

61. (Previously Presented) A gas riser duct of a kiln system provided with a system for mixing a process gas flow according to claim 1.